bamic acid is present in the urine of a normal animal, and increases after Eck's operation. It would be interesting therefore to compare these facts with what we know of the increase of ammonia in pathological states of the liver in man. The liver, however, is not the only place where urea is formed, for the urea never completely disappeared in any of these experiments; and it is well known that in sharks which live seventy hours after the removal of the liver, the urea in the muscles does not diminish after the operation.

Such are the chief new facts we have met with in this interesting memoir, and it is certain that these investigations open up a new field for further researches. The other papers[1] contained in this volume call for little comment; they relate chiefly to the digestive and putrefactive processes taking place in the human intestinal tract.

It will be seen, however, that this fourth number sustains the well-earned reputation of the three first ones, and that the archives deserve to take their place among the chief scientific journals which made their first appearance in the year 1892.

STEAM ENGINE TRIALS.

A PAPER on the last series of steam engine trials undertaken by the late Mr. P. W. Willans was read at the meeting of the Institution of Civil Engineers on April 11.

The paper dealt with an extensive series of condensing trials made with a 40 I.H.P. Willans Central-Valve Engine. These were intended to form a sequel to the investigations described in the author's papers, entitled "Economy Trials of a Non-condensing Steam Engine, Simple, Compound, and Triple," read before the Institution in 1888 and 1889. The principal objects in undertaking these trials were—(1) To ascertain the initial condensation in the first cylinder, and to trace the behaviour of the steam in the succeeding cylinders, when working as a compound or triple-expansion engine; (2) To observe the effect of speed of rotation, area of exposed surface, and range of temperature, upon the initial condensation, and upon economy generally; (3) To ascertain the percentage of the theoretical mean pressure actually obtained; (4) To ascertain the ratio of the work done by each pound of steam to the theoretical work due from it; (5) To determine the consumption of steam at all loads, and under various conditions.

The consumption of steam was determined by discharging the condensed water from the exhaust into a tank carried by a weigh-bridge, and observing the intervals of time required for fixed weights of water to run in. By this method, a continual watch was kept on the performance of the engine during the whole trial, and any disturbing cause was immediately detected; leaky steam-pipe joints did not affect the result, and the length of the trial might be much reduced. Special experiments, made to ascertain whether any addition was necessary to cover leakage in the engine and exhaust-pipe, showed that this leakage was slight.

The method of determining the theoretical work due from one pound of saturated steam when discharging into a condenser was next considered, and it was shown that the thermal efficiency of a condensing engine must of necessity be less than that of a non-condensing engine, owing to the greater proportionate size of the "toe" of the diagram cut off for practical reasons. In the non-condensing trials the best number of expansions was computed from the approximate formula $p^8 v^7 = \text{constant}$; but for the condensing trials the error in this could not be neglected. The best ratio of expansion and mean pressure were therefore calculated for adiabatic expansion, by Mr. Macfarlane Gray's $\theta\ \phi$ diagram, combined with a volume curve. Altogether sixty-two trials were made under various conditions of speed, steam-pressure, load, and ratio of expansion, as well as with the engine working simple, compound, and triple, and the results were embodied in the tables accompanying the paper.

One of the principal deductions from these experiments was the "straight-line" law of steam-consumption; and it was shown by diagrams that the *total* water for the horse-power corresponding to any mean pressure P, was $W + K P.$, where W was the water which would be used by the engine at zero mean pressure (through initial condensation, radiation and conduction), supposing it were frictionless, and K was the water per hour required to produce each pound of mean pressure. These factors were shown to vary with the conditions under which the engine was working.

Eighteen of the trials were planned to assist in determining the law connecting initial condensation with revolutions; and it was found that in the high-pressure cylinder at high mean pressures the total condensation per unit of time was directly proportional to the square root of the number of revolutions per unit of time. As the mean pressure was diminished, the condensation became more and more nearly constant at all speeds; and finally, at low mean pressures, the law appeared to be reversed. For the low-pressure cylinder, the law was modified.

The important question of the changing proportions of steam and water present during the expansive part of the stroke was investigated by the $\theta\ \phi$ diagram. The matter was first examined theoretically by considering the effect of a thin liner of infinitely conducting matter, and a curve was drawn on the $\theta\ \phi$ diagram showing the rate at which the steam initially condensed in warming up the liner from the exhaust to the initial temperature was re-evaporated as the expansion proceeded. The actual re-evaporation, as obtained by measurement of the indicator cards was compared with this theoretical re-evaporation, the difference measuring the delay in the return of the heat from the liner to the steam. The losses due to conduction and radiation, to passage through ports, and to incomplete expansion, could also be shown on the $\theta\ \phi$ diagram.

The question of the economical advantage of reducing the power by automatic cut-oft *versus* throttling was discussed. Broadly, the result was that the gain by varying the expansion was large for a simple engine, moderate for a compound engine, and, for a triple engine, almost inappreciable. It further appeared that the gain at high speeds was greater than at low speeds.

A few trials made with the cylinders steam-jacketed showed a slight gain, but further experiments were required to show whether the gain was likely to be worth the extra trouble and expense involved.

The missing steam at cut-off varied in the trials to even a greater extent than it did in the non-condensing trials—the amount being much affected by the range of temperature, the density of the steam, and by other conditions.

It appeared that, under all circumstances, the triple-condensing engine showed an advantage over the compound in regard to steam-consumption; but that, except for very large engines, the compound-transfer engine was probably the best for pressures below 150 lbs. (absolute) pressure per square inch.

ETHNOLOGICAL OBSERVATIONS IN AUSTRALIA.

SOME time ago Mr. R. Etheridge, jun., carried on a series of geological and ethnological investigations in the valley of the Wollondilly River, at its junction with the Nattai River, New South Wales; and in the latest number of the "Records of the Australian Museum" (vol. ii. No. 4) he gives an interesting account of the various facts he had occasion to study. The following is the greater part of the passage in which he records his ethnological observations:—

The aborigines of the Wollondilly and Nattai Valleys, must, from local accounts, have existed in considerable numbers, and are now only represented by interments, carved trees, wizards' hands, and charcoal drawings in rock shelters along the precipitous escarpments.

The first objects investigated under this head were the "Hands-on-the-Rock." The "rock" consists of a huge mass of Hawkesbury Sandstone, about seventeen feet in breadth and length, hollowed out on the side overlooking the river to the extent of six feet. It is perched on the side of a gentle rise from the Wollondilly, having rolled from the higher ground above, and alongside the track from the Nattai Junction to Cox's River, in the immediate south-west corner of the Parish Werriberri. The cavernous front of the rock is fifteen feet broad, and twelve feet high. On the back wall are depicted a number of red hands, both right and left. Under the principal hands are four white curved bands, resembling boomerangs or ribs, the whole of the hands being relieved, as is usually the case with these representations, by light splash-work. The hand-marks in this shelter differ, however, from any I have seen before by an unquestionably previous preparation of the rock surface for their reception by incising the surface to the shape of each hand, thus leaving a slightly raised margin around each. I have recently given (Records Geol. Survey, N.S. Wales, 1892, iii. Pt. i. p. 34) an epitome of our knowledge of these hand imprints, their method of preparation, and supposed significance sufficiently full to render any further reference unnecessary at present. The colour red, amongst black races, was the symbol of evil (Fraser, Journ. R. Soc., N.S. Wales for 1882 [1883], xvi. p. 213).

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[1] "On the Putrefactive Processes in the Large Intestine of Man and on the Microbes Causing Them," by M. Lumft. "On the Micro-organisms in the Organs of Choleraic Patients," by M. L. de Rekowski. "Contributions to the Study of Chemical Processes in the Intestines of Man," by M. Jakowski.

Mr. Maurice Hayes, of Queahgong, informed me that he has known the rock for the past fifty years, and that the imprints have not altered in the least. He found it difficult to obtain trustworthy information from the aborigines regarding them; they expressed ignorance, but ultimately gave him to understand that the "hands were the imprints of those of their Deity when on earth."

The large alluvial flats in this neighbourhood, along the Wollondilly, were, I was informed, great gathering grounds for the various tribes from many miles round, even those of Goulburn and Shoalhaven participating.

On a spur overlooking one of these green expanses, known as Gorman's Flat, immediately at the junction of the Wollondilly and Nattai Rivers, we investigated an interment, thirty years old, indicated by a single carved tree, but the device has, I regret to say, been wantonly destroyed. This grave is known to be that of "Jimmy Aremoy," or "Blackman's Billy," of the local tribe, and called in the aboriginal dialect *Ah-re-moy*, and was covered by a small mound at the foot of a small tree, forty-seven feet north of the carved tree, and had been surrounded by a sapling fence. After removing the mound and superincumbent soil, we found the grave had been filled with boulders and large pieces of rock to the depth of four feet six inches, whilst under this was a layer of split timber and bark. On removing this we found the skeleton well wrapt in what had once been an old coat, a blanket, and an opossum rug. The skeleton was doubled up in the usual manner, the arms drawn up to the breast, and the legs against the abdomen, placed on the right side, and facing the south-east. . . . Not the least interesting fact was the variety of articles placed with the deceased, according to aboriginal custom. Loose in the superincumbent earth we found an ingenious conversion of a piece of forked iron into a probable spear-head, a pointed stick, and some loose pieces of timber. Underneath the skeleton in various positions there occurred an old comb in two pieces, a thimble, a large iron spoon, the blade of another spoon, a small bullet mould, handle and portion of the tin-plate work of an old "quart-pot" or "billy-can," fragment of a clay tobacco pipe-stem, top of an old metal powder or shot case, containing shot and a few shirt buttons, and last, but by no means the least curious, a castor oil bottle, still containing what seems to be a portion of the oil—this was placed directly under the head.

A little below the junction of the rivers we viewed the burial place of a "Chief" of the late local tribe, the interment having taken place about fifteen years ago. It lies contiguous to one of three marked trees placed in a triangle, the longest side or base of the latter being half a chain in length, and bearing north-west and south-east. The trees are still erect, although the carvings are more or less obliterated by bush fires, but they seem to have been chiefly in zig-zag lines, and of course cut with an iron tomahawk. The heavy rain prevailing at the time deterred us from investigating this burial.

This concluded our investigations in Burragorang proper, but on returning to Thirlmere, we diverted our course near Vanderville, across the Werriberri Creek to "The Hermitage," the estate of Mr. W. G. Hayes, parish of Burragorang, county of Camden. Through the kindness of Mr. Hayes we were allowed to examine a much more extensive burial ground than either of the preceding. Here, on a small plateau above and to the east of the Waterfall Creek, a branch of the Werriberri, and behind, or to the south of the homestead, are four graves of various sizes distinguished by four carved trees, more or less in a state of dilapidation. There does not appear to have been any geometrical form of arrangement assumed in the placing of these graves, unless it be a roughly rhomboidal one. We expected, from current report, to find five graves here, but four only rewarded our efforts. Three of the graves and three carved trees are more or less in a north-west and south-east line. Starting at the north-west corner, the figures on a She-oak (*Casuarina*) have been partially obliterated, ten feet from this is the first grave, and fourteen feet from the latter is another carved She-oak, now lying on the ground and much decayed. Fifty-one feet still further on occurs the largest grave, and at another fifty-one feet the third ornamented tree, a dead gum still standing but much burnt by bush fires, and bearing an extraordinary figure. Between the last grave and this tree, and deviating somewhat from the straight line in the third interment, at right-angles to the original starting point; and fifty-four feet from it at right angles, is the fourth carved tree, also a dead gum, bearing figures. At right angles to this again, and distant sixty-four feet, is the fourth grave, apparently without any indicating tree near it. We did not investigate the contents of these graves owing to want of time. . . .

I am not acquainted with any systematic account of Australian carved trees; in fact little seems to have been collectively written about them, and very few representations figured. Probably some of the earliest illustrations are those by Oxley, Sturt, and "W. R. G." presumed to be from the context of his writings, Mr. Surveyor W. R. Govett, of Govett's Leap fame. Oxley discovered a grave on the Lachlan, consisting of a semi-circular mound, with two trees overlooking it, barked and carved in a simple manner. (Journ. Two Expeds. Interior N.S. Wales, 1820, p. 139, plate). These carvings consisted of herring-bone on the one tree, and well-marked curved although simple lines on the other. The explorer Sturt noticed an oblong grave beyond Taylor's Rivulet, Macquarie River, around which the trees were "fancifully carved on the inner side," one with a figure of a heart (Two Expeds. Interior S. Austr., 1834, i., p. 14). The anonymous author (W. R. G.) describes an occurrence of this kind at Mount Wayo, County Argyle, in the following words:—"The trees all round the tomb were marked in various peculiar ways, some with zig-zags and stripes, and pieces of bark otherwise cut" (Saturday Mag. 1836, ix., No. 279, p. 184). A Mr. Macdonald states that the aborigines of the Page and Isis, tributaries of the Hunter River, carve serpentine lines on two trees to the north-west of each grave (Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1878, vii., p. 256).

The figures are either composed of right lines or curves, more commonly the former, but a few instances have been recorded of natural objects, such as the outline of an Emu's foot, seen by Leichhardt on a gum tree in the Gulf Country (Journ. Overland Exped. Moreton Bay to Port Essington, 1847, p. 356). One thing is self-evident, such carvings possessed a dual if not a triple significance. We have already seen the employment of them to indicate an interment, presumably acting the part of a tombstone, for it is believed by some that the figures on a tree in each case correspond to those on the inner side of deceased's 'possum rug, the *mombarai*, or "drawing," which Fraser thinks was distinctive in each family, or a peculiar modification of the tribal *mombarai* (Journ. R. Soc. N.S. Wales for 1892 [1893], xvi., p. 201). So far as I can gather, such devices invariably indicated the last resting-place of a male. Mr. E. M. Curr states ("The Australian Race, 1886," ii., p. 433) that the Breeaba Tribe, at the head-waters of the Burdekin River, North Queensland, employed marked trees to commemorate a battle. He figures a tree from the banks of the Diamantina, barked and marked by a series of close, irregularly super-imposed notches, like those made by a black when climbing a tree. These, however, can hardly be compared to carvings.

According to Mr. J. Henderson, Dr. John Fraser, Mr. A. W. Howitt, and Mr. Macdonald previously mentioned, Bora Grounds are also embellished with carved trees. The first-named describes ("Obs. Colonies of N.S. Wales and V.D. Land," 1832, p. 145, pl. 3) the approach to one of these initiation places at Wellington as through "a long, straight avenue of trees, extending for about a mile, and these were carved on each side with various devices . . . At the lower extremity of this, a narrow pathway turned off towards the left, and soon terminated in a circle." Mr. Henderson further remarks that the fact of the use of this place for Bora purposes was communicated to him by the then headman of the tribe. Dr. Fraser says (Journ. R. Soc. N.S. Wales for 1882 [1883] xvi., p. 205) that the Gringai Tribe, one of the northern N.S. Welsh tribes, clear two circular enclosures, one within the other, for their Bora, and that the trees growing around the smaller circle are carved "with curious emblematical devices and figures"; whilst Mr. Macdonald informs us that on the Bora ground of the Page and Isis River Natives, as many as a hundred and twenty marked trees occur round about (Journ. Anthrop. Inst. Gt. Brit. Ireland, 1878, vii., p. 256). Confirmation is further afforded by Mr. W. O. Hodgkinson, who saw a Bora ground on the Macleay River with "trees minutely tatooed, and carved to such a considerable altitude that he could not help feeling astonished at the labour bestowed on the work" (Smyth, "Aborigines of Victoria, 1878," i., p. 292).

If, as previously stated, according to current report, the designs on the trees be the same as those on the 'possum rugs, the transfer of them to the trees surrounding a grave must have had some important and lasting meaning to the survivors. The figures on the rug may have indicated some degree of ownership, a crest, coat of arms, or monogram, as it were, and in such a case the reproduction on the trees surrounding a grave may be looked upon as an identification of the deceased. Henderson speaks of the tree carvings as symbols. "A symbol is afterwards carved upon the nearest tree, which seems to indicate the particular tribe to which the individual may have belonged" ("Obs. Colonies of N.S. Wales and V.D. Land, 1832," p. 149). Or had they a deeper esoteric meaning, one only known to the learned men of the tribe? Smyth states ("Aborigines of Victoria, 1878," i., p. 288) that the figures on the inner sides of the 'possum rugs "were the same as those on their weapons, namely, the herring-bone, chevron, and saltier." How easily these same devices can be traced, in a general way, both on the carved trees and some of the wooden weapons, is amply shown by many of the excellent figures given in Smyth's work. This painstaking author, in briefly dealing—too briefly, in fact—with this interesting subject, says (*Ibid.* p. 286. The italics are mine): "The natives of the Murray and the Darling, and those in other parts adjacent, carved on the trees near the tombs of deceased warriors *strange figures having meanings no doubt intelligible to all the tribes* in the vast area watered by these rivers." By the Kamilarai (T. Honery, Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1878, vii., p. 254) they were regarded as "memorials of the dead.

It is much to be regretted that before the last remnant of this fast-disappearing race has passed away, a translation, or at any rate an explanation of these matters, cannot be obtained.

SCIENTIFIC SERIALS.

American Journal of Science, April.—Distance of the stars by Doppler's principle, by G. W. Colles, Jun. This principle may be applied to the calculation of the distances of stars in the manner suggested by Fox Talbot and discussed by Prof. Rambaut. If the velocity of a component of a binary star be measured spectroscopically when it is moving in the line of sight, and its orbit be studied by means of the micrometer, the velocity at any point of the orbit, and hence also the size of the orbit, may be determined. This, divided by its angular magnitude, gives the distance of the system. From theoretical considerations the author calculates the ratio of the mean velocity across the line of sight of a large number of stars distributed equally over the celestial sphere to their mean velocity along the line of sight, and finds this ratio to be $\frac{\pi}{2}$. He then shows that the mean distance of all these stars will be approximately arrived at by multiplying this ratio by the sum of the observed velocities in the line of sight, and dividing by the sum of the observed corresponding angular velocities. Calculating from observations of ninety-five stars in the northern hemisphere, a mean distance of 150·9 light years is obtained, or, taking Vogel's observations only, 80·5 light years.—The radiation and absorption of heat by leaves, by Alfred Goldsborough Mayer. Two leaves of the same species of plant were each glued upon one of the polished tin sides of a Leslie cube. One of the leaves was then painted over with dead-black, and the cube was filled with water kept at 40° C. The radiation from the two leaves was measured by means of a thermopile. It was found that almost all the leaves radiated as well as lampblack. The effect of a thin film of dew was to reduce the radiation to 78 per cent, and to 66 per cent. if the dew stood out in beads upon the surface. The absorption of dark heat rays by leaves interposed as a diaphragm was found to be highly selective. A single elm leaf transmitted 20 per cent. of the radiant heat. A second leaf transmitted 78 per cent. of this, and a third over 83 per cent. of that transmitted by the second. Wild cherry leaves transmitted 9 per cent., and chicory 4 per cent. more heat when their chlorophyll was abstracted by ether or alcohol.—Also papers by Messrs. H. L. Wheeler, W. P. Headden, W. H. Melville, J. F. Kemp, E. A. Smith, R. T. Hill, M. I. Pupin, F. A. Gooch, and P. E. Browning.

THE most important article in the *Botanical Gazette* for December, 1892, is the one to which we have already alluded, in which Mr. R. Thaxter proposes the establishment of a new order of Schizomycetes with the name Myxobacteriaceæ. In that and the following numbers (January—March, 1893) Prof. D. H. Campbell gives his account, most of which we have reprinted, of his visit to the Hawaiian Islands; Mr. G. W. Martin completes his description of the development of the flower and embryo-sac in *Aster and Solidago*; Mr. F. B. Maxwell gives a comparative study of the roots of Ranunculaceæ, in which he makes three types of structure on the basis of the changes which take place through secondary growth. Mr. A. Schneider has a note on the influence of anæsthetics on the transpiration of plants; he finds that both this function and the vitality of protoplasm are both retarded by the action of ether, the protoplasm being finally killed. Prof. J. E. Humphrey gives a full account of the life-history of *Monilia fructigena*, a parasitic fungus which causes great destruction of pears and stone-fruit in America. In an article on non-parasitic bacteria in vegetable tissue Mr. H. L. Russell sums up his conclusion that vegetable, like animal tissues, are normally free from micro-organisms, but that in healthy vegetable tissues many species of bacteria are able to exist for a not inconsiderable length of time. We have also articles describing new species of flowering plants discovered on the American continent, and a *résumé* of the botanical papers read at the New Orleans meeting of the American Association for the Advancement of Science.

IN the numbers of the *Journal of Botany* from January to April the articles of most general interest, in addition to the continuation of others already noticed, are:—A list of the Mycetozoa of South Beds and North Herts, by Mr. Jas. Saunders; Dr. M. T. Masters, on some cases of inversion, in which he gives illustrations of the reversal of the normal relative position of organs or of elements of tissues; a provisional list of the marine algæ of the Cape of Good Hope, by Miss E. S. Barton; a list of the mosses of Guernsey, by Mr. E. D. Marquand; notes on Scotch freshwater algæ, by Mr. W. West, in which two new species are described; notes on the British species of *Campylopus*, a genus of Musci, by Mr. H. N. Dixon. Under the head of "Laboratory Notes," Mr. S. Le M. Moore describes the best way of making Millon's reagent; a new way of demonstrating continuity of protoplasm (Millon's fluid); and the action of cold Millon's fluid on iron-greening tannins, and on cell walls giving proteid reactions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 2.—"A New Portable Miner's Safety-lamp, with Hydrogen attachment for delicate Gas-testing; with exact Measurements of Flame-cap indications furnished by this and by other Testing-lamps." By Prof. Frank Clowes, D.Sc. (Lond.), University College, Nottingham.

The author, availing himself of his "test-chamber," already described in the Proc. Roy. Soc. vols. l. li. has examined the indications of fire-damp furnished by the different safety-lamps at present in use for testing purposes. These lamps include the ordinary oil-lamp, the Pieler alcohol lamp, the Ashworth benzoline lamp, and the hydrogen-oil lamp, recently devised by the author.

The introduction of a standard hydrogen gas-testing flame into an ordinary oil safety-lamp was first effected by the author, and was described by him in the papers referred to above. But it has now been brought into a far more convenient and portable form; the most recent development of the lamp is described and explained by illustrations in the present paper. The hydrogen gas is stored in a little pocket steel cylinder, under about 100 atmospheres pressure: this can be immediately attached to the safety-lamp when required, and can be made to furnish a standard 10 millimetre hydrogen flame which will burn continuously for forty minutes from the cylinder-supply. The hydrogen is kindled from the oil-flame, without opening the